Instruction Guide for Field Data Sheet: Road – Stream Crossing Inventory

OVERVIEW

The River/Stream Continuity Project is a pilot project that trains volunteers to inventory river and stream road crossings. This information will be used to help determine if crossings are a barrier to fish and wildlife movement, and cause habitat fragmentation. Barriers that are identified will be prioritized on a watershed and town level for further remediation.

These instructions provide additional explanations for the questions on the Road – Stream Crossing Inventory Field Data Form. Remember that the data form is for the entire river or stream crossing, which might include multiple culverts or multiple cell bridges. With the exception of dimensions, answer each question for the crossing as a whole. For example, if one culvert at a multiple culvert crossing is fully embedded, then check "fully embedded" on the data form. It is not necessary that every cell of a multiple cell bridge crossing span the channel. Look instead to determine whether, for example, the combination of cells collectively spans the stream channel.

Please be sure to answer every question.

SHADED BOXES

The Survey Coordinator will provide the necessary information for these boxes. These include "Coordinator" and "Crossing ID#." Do not enter data in these boxes.

BASIC INFORMATION

Date – Date that the crossing structure was evaluated.

Stream/River – Provide the name of the stream or river. Use "unnamed" if the waterway is not named or "unknown" if you are not sure.

Road – Name of the road or "unnamed" if the road does not have a name. Use "unknown" if you are unsure whether or not the road is named or you don't know the road name.

Town – Town where the crossing occurs.

Location – Provide enough information about the exact location of the crossing so that another person using your data sheet will be confident that they are at the same crossing that you evaluated. For example "between telephone poles # 162 and 163" or "right across from the Depot Restaurant."

GPS Coordinates (lat/long) – If you have access to a GPS (Global Positioning System) unit, provide the latitude and longitude for the crossing location. Enter "NA" if you don't have this information.

Observer – Your name.

Phone # - A phone number where you can be reliably reached.

Email address – Your email address if you have one. Otherwise enter "NA."

Photo IDs – If you took digital photos record the ID numbers following the photo inventory protocol. Enter "none" is you did not take photos. Take a magnetic north compass bearing through the culvert from the upstream end (Bearing US), and downstream end (Bearing DS).

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ROAD /RAILWAY CHARACTERISTICS

1. Number of travel lanes - This refers to the total travel lanes present not counting shoulders or breakdown lanes (two each way = 4 total lanes).

Road Shoulder / Breakdown Lane - Check "Yes" if there is one present.

Road Surface - Check "Paved" or "Unpaved".

2. Conditions inhibiting wildlife crossing – Check "Yes" if any of the following conditions exist at the stream crossing to such an extent that they would significantly inhibit wildlife crossing over the road surface: High traffic volume, Steep embankments, Retaining walls, Jersey barriers, Fencing, other.

High traffic volume. Check "yes" if the level of traffic is enough to significantly reduce the chance that wildlife will successfully cross the road or highway (e.g. greater than 50 cars per minute).

Steep embankments should be noted on the form if, in your judgment, they are steep enough and extensive enough (height and width) that they would significantly inhibit wildlife movement up and over the road.

Retaining walls are sometimes concrete, but can also be made of riprap enclosed in metal fencing or baskets, and are used to maintain steep slopes adjacent to roads.

Jersey barriers are concrete blocks that are lined up end to end past edges of roadways and are not passable to wildlife.

Fencing. Check "yes" if fencing extensive enough to block wildlife passage across the road is present on one or both sides of the road/highway.

Guard rails (metal or cable) may be important for some species, similar to curbing.

Curbs are important to note because small wildlife, like turtles and salamanders, that can get onto the road may be blocked at the other edge if faced with even a 6" curb.

CROSSING / STREAM CHARACTERISTICS

3. Crossing type - See picture of ford, bridge, open bottom arch, single culvert, multiple culverts to determine crossing type.

3a. Construction material – may help future maintenance planning depending how durable the material.

4. Condition of crossing – Check off appropriate boxes – new, old, collapsing, eroding (around culvert or underneath), rusted, broken, "other" – e.g. "dented at inlet, filled with sediment". Describe what you see.

5. Is the stream flowing in the natural channel? – Check "Flowing" if stream is flowing in the stream upstream and downstream of the crossing. For "Flowing" water must be moving and consistent. Check "Ponded" if there is still water in the channel, but it is not flowing. Check "dry" if there is no water in the crossing, nor immediately upstream or downstream of the culvert.

6. Flow conditions during the survey: Check the appropriate box to indicate whether flow conditions during the survey were: unusually low, typical low-flow, average flow (not low-flow), or higher than average. Survey results are most useful when data are collected during typical low-flow conditions.

7. Are any of the following problems present? – Measure or estimate, in inches, the perch (inlet) or drop (outlet) from the bottom of the pipe to the water surface.

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Inlet drop: Where water level drops suddenly at the crossing inlet, causing changes in water speed and turbulence. In addition to the higher velocities and turbulence, these jumps can be physical barriers to fish and other aquatic animals when they are swimming upstream and are unable to swim out of the culvert. Only measure if it is safe to access the pipe, otherwise estimate the drop and check the appropriate box.

Outlet perch: When water drops off or cascades down from the outlet, usually into a receiving pool. This may be due to the original design or erosion of material at the downstream end of crossing. Outlet drops create barriers to the upstream movement of fish and other aquatic animals that are unable to jump up over the drop. Only measure if it is safe to access the pipe, otherwise estimate the drop and check the appropriate box. If the outlet is perched, check cascade if the water tumbles over rocks, logs, or other debris; or freefall, if the water falls directly into the pool below.

Flow Contraction: When the crossing is smaller than the stream width the flow will be constricted at some flows creating flow contraction. The increased velocities and turbulence associated with flow contraction can block fish and wildlife passage. Check "yes" if flow contraction at the inlet is creating noticeable turbulence or results in an inlet drop.

8. Tailwater armoring: This includes concrete aprons, plastic aprons, riprap or other structures added to crossing outlets to facilitate flow and prevent erosion. Indicate on the data form whether tailwater armoring at the outlet of the crossing is "extensive", "not extensive" or absent ("none").

9. Tailwater scour pool: These are pools created downstream as a result of high flows exiting the crossing. A scour pool is considered present if the pool is wider than the natural stream channel and/or the banks are eroded. Check "large" if the width or depth of the pool is approximately twice that of the natural stream channel or more. Otherwise, check either "small" if a smaller pool exists or "none" if there is no scour pool.

10. Physical barriers to fish and wildlife passage: This includes any structure that physically blocks fish or wildlife movement. If physical barriers exist indicate whether they are "permanent" or "temporary" barriers, and describe them on the data form. Otherwise check "none." Beaver dams, debris jams, accumulations of sediment are examples of what might be considered temporary barriers. Fences, rocks, cross pipes, concrete aprons, sediment filling a culvert, weirs, baffles, and gabions are examples of structures that might be or cause permanent physical barriers. Weirs are short dams or fences in the stream that constrict water flow or fish movements. Baffles are structures within culverts that direct, constrict, or slow down water flow. Gabions are rectangular wire mesh baskets filled with rock that are used as retaining walls and erosion control structures.

11. Crossing substrate: An "embedded" culvert is a culvert that is installed in such a way that the bottom of the structure is below the stream bed and there is substrate in the culvert. Indicate on the data form whether or not the culvert has substrate and how much substrate there is through the crossing. If the culvert is not buried and generally lacks substrate, then check "no substrate". If the culvert is partially buried and contains substrate for half or more of its length, check "partial substrate." If the culvert is buried for its entire length but substrate depth is not at least 1 foot throughout, check "substrate < 1'". If the culvert is buried and contains at least 1 foot of substrate throughout, check "substrate > 1'." If the crossing is a bridge, ford, or open-bottom arch check "substrate > 1'."

12. Crossing substrate: Record whether the substrate in the crossing is "natural", "non-natural", "contrasting", "comparable.". "Natural" reflects substrate that came from

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surrounding landscape, compared to concrete, riprap, crushed rock, or other imported material. Large riprap and concrete are examples of substrates that are non-natural and contrasting from the river- or stream-bed. Check "contrasting" if the substrate is clearly different in size and shape than that in the natural stream channel. For example, if the crossing's predominant substrate is boulders and large cobble on a stream where the natural stream bottom is predominantly mud/muck. Check "comparable" is the substrate in the crossing is similar to that found in the natural stream channel. This field can contain multiple checks (e.g. natural and contrasting). Add any comments if needed.

13. Does the water depth in crossing match the stream depth? – Check "yes" if water depth in the crossing is comparable to the depths upstream and downstream in the natural stream channel. Comparable means that the depth in the crossing falls within the range of depths naturally occurring in that reach of the stream. Compare the depth in the crossing with ~100 feet (or "line of site") both up and downstream of the crossing. Check "no, significantly deeper" if the water depth in the crossing is deeper from that found in the stream, and "no, significantly shallower" if the depth is shallow compared to the natural stream channel.

14. Does the velocity of the water in crossing match that of the stream? – Check "yes" if water velocities in the crossing are comparable to the velocities in the nature stream channel upstream and downstream of the crossing. Comparable means that the velocities in the crossing fall within the range of velocities naturally occurring in that reach of the stream. Compare the velocity in the crossing with ~100 feet (or "line of site") both up and downstream of the crossing. Check "no, significantly faster" if the water velocity in the crossing is moving faster from that found in the stream, and "no, significantly slower" if the velocity is slower compared to the natural stream channel.

15. Does the crossing slope match that of the stream? – Check "yes" if the crossing slope is comparable to the slope in the nature stream channel upstream and downstream of the crossing. Comparable means that the slope in the crossing falls within the range of the slope naturally occurring in that reach of the stream. Compare the slope in the crossing with ~100 feet (or "line of site") both up and downstream of the crossing. Check "no, significantly steeper" if the slope in the crossing is steeper that found in the stream, and "no, significantly flatter" if the slope is shallower compared to the natural stream channel.

16. Crossing span: Check the appropriate description from the list below. Natural streams are variable in width. In selecting the appropriate category consider the average conditions in the natural stream channel outside the influence of the crossing itself.

Constricts channel: The crossing is narrower than the actively scoured streambed (see next category for a description) in the natural channel upstream and downstream of the crossing.

Spans active channel: Choose this option if the crossing spans the active channel, but not the bankfull width of the stream. The active channel is that portion of the stream that is frequently wetted during storm events. Indicators of the active channel include[1]:

- Edge of frequently scoured substrate
- Break in rooted vegetation or moss growth on rocks along stream margins
- Natural line impressed on the bank
- Shelving
- Changes in soil character

[1] From a draft "California Salmonid Stream Habitat Restoration Manual, Part X: Fish Passage Evaluation at Stream Crossings" by Taylor and Love, 2001.

Spans bankfull width: Choose this option if the crossing spans the bankfull width of the channel, but does not include the banks the stream. Bankfull is amount of water that just fills the stream channel and where additional water would result in a rapid widening of the stream or overflow into the floodplain. Indicators of bankfull width include[2]:

- Abrupt transition from bank to floodplain. The change from a vertical bank to a horizontal surface is the best identifier of the floodplain and bankfull stage, especially in low-gradient meandering streams.
- Top of pointbars. The pointbar consists of channel material deposited on the inside of meander bends. Set the top elevation of pointbars as the lowest possible bankfull stage.
- Bank undercuts. Maximum heights of bank undercuts are useful indicators in steep channels lacking floodplains.
- Changes in bank material. Changes in soil particle size may indicate the operation of different processes. Changes in slope may also be associated with a change in particle size.
- Change in vegetation. Look for the low limit of perennial vegetation on the bank, or a sharp break in the density or type of vegetation.

Spans channel and banks: Choose this option if the crossing structure spans the bankfull channel width and one or more of the banks with sufficient headroom to allow dry passage for some wildlife.

17. Minimum structure height at low water – (From water level to the roof inside the structure). Measure the height within the structure and determine which category it falls in - >6ft, 4-6 ft, < 4ft – and check appropriate box.

18. Comments – On the back of the field form, add anything you feel may not have been included, but is important for describing the crossing. Include diagrams or sketches if desired.

[2] Adapted from Georgia Adopt-A-Stream "Visual Stream Survey" manual. Georgia Department of Natural Resources, 2002.

CROSSING DIMENSIONS

Crossing Type – Choose the most appropriate choice from #1-9 or Ford that describes the type of crossing.

1.-Open Bottom Arch will look like a pipe culvert on the top half, but you will not see a bottom half. Instead for the bottom, it has metal footings that are sunk into concrete below the stream channel.

2.-Bridge with abutments will have sides at right angles, but no bottom structure.

3.-Bridge with side slopes will have angled sides, and no bottom structure.

4.-Bridge with side slopes and abutments will have both sloping sides as well as sides at right angles to give the bridge height over the stream.

5.-Round Culvert will be a circular pipe.

6. Elliptical Culvert will have a wider squashed look then a round pipe culvert.

7. Box Culvert will usually be made of concrete.

8. Embedded Round Culvert means that the culvert is partially buried below the stream channel so that natural sediment will flow through and you won't see the bottom of the culvert.

9. Embedded Elliptical Culvert Also known as a "pipe arch" this is an elliptical culvert where the bottom has been buried below the stream channel.

Ford is a shallow water crossing directly across the streambed, often with logs, stone, or gravel to protect or stabilize the bottom. These are rare, and are mostly found on roads that are not frequently used.

Upstream /Downstream dimensions (ft.) Provide the measurements shown in the appropriate diagram for the crossing type. **(If measurements cannot be taken, please estimate and write EST. after estimated measurement.)**

A. Measure interior width of crossing.

B. Measure height from underside of crossing to **water surface**. (Measure to stream bottom if there is no flow.)

C. Measure width of actual stream channel (wetted width) through crossing structure if natural bottom exists (i.e. bridges or embedded culverts).

D. Measure height of vertical abutments from underside of bridge to where sides start sloping.

Length of stream through crossing (ft.) Measure the crossing from inlet to outlet by walking through it if it is large enough and safe. If walking through culvert is not possible, then hold measuring tape at inlet and let current carry it to outlet where someone else catches it and measures the length. Another option is to stand on top of it and measure length along road.

DIMENSIONS FOR MULTIPLE CULVERT CROSSINGS

When inventorying multiple culverts, label left culvert 1 and go in increasing order from left to right from downstream end (outlet) looking upstream.

Number of Culverts or Bridge Cells – How many culverts are present? Include ones that may not have any flow. How many separate channels flow beneath the bridge due to piers, footings, or debris etc.?

Upstream/ Downstream dimensions: Follow the same instructions as above.

If measurements cannot be taken, please estimate and write EST. after estimated measurement.

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Glossary

→ **Active Channel** – The active channel is that portion of the stream that is frequently wetted during storm events. Indicators of the active channel include:

- Edge of frequently scoured substrate
- Break in rooted vegetation or moss growth on rocks along stream margins
- Natural line impressed on the bank
- Shelving
- Changes in soil character

→ **Bankfull Width** – Bankfull is amount of water that just fills the stream channel and where additional water would result in a rapid widening of the stream or overflow into the floodplain. Indicators of Bankfull width include:

- Abrupt transition from bank to floodplain. The change from a vertical bank to a horizontal surface is the best identifier of the floodplain and Bankfull stage, especially in low-gradient meandering streams.
- Top of pointbars. The pointbar consists of channel material deposited on the inside of meander bends. Set the top elevation of pointbars as the lowest possible Bankfull stage.
- Bank undercuts. Maximum heights of bank undercuts are useful indicators in steep channels lacking floodplains.
- Changes in bank material. Changes in soil particle size may indicate the operation of different processes. Changes in slope may also be associated with a change in particle size.
- Change in vegetation. Look for the low limit of perennial vegetation on the bank, or a sharp break in the density or type of vegetation.

→ **Culvert –** Round, elliptical or rectangular structures that are fully enclosed (contain a bottom) designed primarily for channeling water beneath a road, railroad or highway.

→ **Embedded Culvert** – A culvert that is installed in such a way that the bottom of the structure is below the stream bed and there is substrate in the culvert.

→ **Flow contraction** – When culvert is significantly smaller then stream width the converging flows creates a condition called "flow contraction." The increased velocities and turbulence associated with flow contraction can block fish and wildlife passage.

→ **Ford –** Modified or unmodified portions of a stream or river where vehicle drive through rather than over the streambed. Vented fords provide culverts to pass water during low flows while higher flows pass over the ford.

→ **Inlet drop** – Where water level drops suddenly at an inlet, causing changes in water speed and turbulence. In addition to the higher velocities and turbulence, these jumps can be

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physical barriers to fish and other aquatic animals when they are swimming upstream and are unable to swim out of the culvert.

→ **Open Bottom Arch –** Arched crossing structures that span all or part of the stream bed, typically constructed on buried footings and without a bottom.

→ **Openness ratio –** Equals cross-sectional area of the structure divided by crossing length when measured in meters. For a box culvert, openness = (height x width)/ length.

→ **Orifice flows –** Flows that fill or nearly fill the entire culvert. These become problematic because there is no space within the culvert for wildlife passage and flows are typically too fast for the passage of fish and other aquatic animals.

→ **Outlet drop** – An outlet drop occurs when water drops off or cascades down from the outlet, usually into a receiving pool. This may be due to the original culvert placement or erosion of material at the downstream end of culvert. Outlet drops are barriers to fish and other aquatic animals that can't jump to get up into the culvert.

→ **Physical barriers to fish and wildlife passage** – Any structure that physically blocks fish or wildlife movement as well as structures that would cause a culvert to become blocked. Beaver dams, debris jams, fences, sediment filling culvert, weirs, baffles, aprons, and gabions are examples of structures that might be or cause physical barriers. Weirs are short dams or fences in the stream that constrict water flow or fish movements. Baffles are structures within culverts that direct, constrict, or slow down water flow. Gabions are rectangular wire mesh baskets filled with rock that are used as retaining walls and erosion control structures.

→ **Pipe Arch** – A pipe that has been factory deformed from a circular shape such that the width (or span) is larger that the vertical dimension (or rise), and forms a continuous circumference pipe that is not bottomless.

→ **Tailwater armoring** – Concrete aprons, plastic aprons, riprap or other structures added to culvert outlets to facilitate flow and prevent erosion.

→ **Tailwater scour pool** – A pool created downstream from high flows exiting the culvert. The pool is wider than the stream channel and banks are eroded.